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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	COMP:0016	Total Pages	84
First Named Inventor or Application Identifier			
Paily T. Varghese			
Express Mail Label No.	EL 066000037 US		

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: **Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231**

1. ☒ Fee Transmittal Form *(Submit an original, and a duplicate for fee processing)*
2. ☒ Specification *Total Pages* **23** *(preferred arrangement set forth below)*
   - -Descriptive
   - -Cross References to Related Application
   - -Statement Regarding Fed sponsored R & D
   - -Reference to Microfiche Appendix
   - -Background of the Invention
   - -Brief Summary of the Invention
   - -Brief Description of the Drawings *(if filed)*
   - -Detailed Description
   - -Claim(s)
   - -Abstract of the Disclosure
3. ☒ Drawing(s) *(35 USC 113)* *Total Sheets* **6** *Total Pages* **6**
4. Oath or Declaration
   a. ☒ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37CFR 1.63(d)) *(for continuation/divisional with Box 17 completed)* ***[Note Box 5 below]***
      i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference *(useable if Box 4b is checked)* The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. ☐ Computer Readable Copy
   b. ☐ Paper Copy (identical to computer copy)
   c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ☒ Assignment Papers (cover sheet & document(s))
9. ☒ 37 CFR 3.73(b) Statement ☒ Power of Attorney *(where there is an assignee)*
10. ☐ English Translation Document *(if applicable)*
11. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☒ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
14. ☐ Small Entity ☐ Statement filed in prior application Statement(s) Status still proper and desired
15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. ☐ Other

17. ☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: ____/_____

18. CORRESPONDENCE ADDRESS

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PTO/SB/17 (10/96)
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FEE TRANSMITTAL

	Complete if Known
Application Number	Unassigned
Filing Date	Herewith
First Named Inventor	Pailly T. Varghese
Group Art Unit	Unassigned
Examiner Name	Unassigned
TOTAL AMOUNT OF PAYMENT ($) 852.00	Attorney Docket Number COMP:0016

METHOD OF PAYMENT (check one)

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 06-1315/COMP:0016 (YOD)

Deposit Account Name: Fletcher, Yoder & Edwards

☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17 ☐ Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance, 37 CFR 1.31(b)

2. ☒ Payment Enclosed:

☒ Check ☐ Money Order ☐ Other

FEE CALCULATION (fees effective 10/01/97)

1. FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	790	201	395	Utility filing fee	790.00
106	330	206	165	Design filing fee	
107	540	207	270	Plant filing fee	
108	790	208	395	Reissue filing fee	
114	150	214	75	Provisional filing fee	
				SUBTOTAL (1)	($) 790.00

2. CLAIMS

	Extra		Fee from below		Fee Paid
Total Claims 21 -20 =	1	X	22.00	=	22.00
Independent 3 - 3 = Claims	0	X	0	=	0
Multiple Dependent Claims		X		=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	22	203	11	Claims in excess of 20
102	82	202	41	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim
109	82	209	41	Reissue independent claims over original patent
110	22	210	11	Reissue claims in excess of 20 and over original patent
				SUBTOTAL (2) ($) 22.00

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Fee Code	Large Entity Fee ($)	Small Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing or cover sheet.	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for response within first month	
116	400	216	200	Extension for response within second month	
117	950	217	475	Extension for response within third month	
118	1,570	218	755	Extension for response within fourth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive unavoidably abandoned application	
141	1,320	241	660	Petition to revive unintentionally abandoned application	
142	1,320	242	660	Utility issue fee (or reissue)	
143	450	243	225	Design issue fee	
144	670	244	335	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40.00
146	790	246	395	Filing a submission after finat rejection (37 CFR 1.129(a))	
149	790	249	395	For each additional invention to be examined (37 CFR 1.129(b))	
Other fee (specify)					
Other fee (specify)					
				SUBTOTAL (3)	($) 40.00

* Reduced by Basic Filing Fee Paid

SUBMITTED BY					Complete (if applicable)
Typed or Printed Name	Michael G. Fletcher	Reg. Number	32,777		
Signature		Date	July 31, 1998	Deposit Acct. User ID	06-1315/COMP:0016/YOD

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P98-2056

COMPUTER COMPONENT RACK MOUNTING ARRANGEMENT

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COMPUTER COMPONENT RACK MOUNTING ARRANGEMENT

BACKGROUND OF THE INVENTION

1. Field Of The Invention

The present invention relates generally to the field of computer systems, such as servers, housed in a rack-mounted support structure. More particularly, the invention relates to a novel sliding rail support structure designed to provide increased internal volume in computer component enclosures in a low-profile rail arrangement.

2. Description Of The Related Art

A variety of mechanical mounting structures have been devised for computer systems. In one type of computer system, typically referred to as server systems, a number of sub-components or servers are arranged in a central cabinet. The server enclosures are typically mounted in the cabinet in stacked vertical arrangements, with each server enclosure being secured within the cabinet by a sliding rail structure. The sliding rail structures permit the servers to be extracted and reinserted easily into the cabinet, such as for servicing of internal components of the servers. In general, it is desirable to allow each server to be fully or nearly fully withdrawn from the cabinet in order to gain a high degree of access to internal components of the individual servers. Following such service, the individual server may be closed and reinserted into the cabinet for normal operation.

Conventional server rail mounting racks include side support rails which interface with a sliding rail. The support rail is mounted within the cabinet, while the sliding rail is secured to the individual server enclosure. Because the servers are often quite heavy, and, when fully extended, constitute a significant cantilevered load, the support and sliding rail structures must offer a considerable resistance to loading, while affording easy sliding motion during displacement of the server.

While sliding rail mounting structure of the type described above are generally quite effective at adequately supporting servers and other computer components, they were not without drawbacks. For example, for ease of servicing of internal components of each individual enclosure, it is desirable to allow some access to internal circuitry housed within each enclosure while not requiring the component enclosure to be removed from the rail mounting structure. While some degree of access may be provided by securing the sliding rail component of the structure adjacent to the bottom of the enclosure, allowing the top of the enclosure to be removed, conventional sliding support structures nevertheless do not provide adequate access to lower regions of the enclosure owing to the height of the sliding rail. Moreover, because the rail structure, including both the support and sliding rails, occupies some lateral volume within the cabinet or rack, the available volume for the circuitry inside each server enclosure is reduced. Conventional enclosures typically include flat vertical side panels which are secured to the sliding rail structures, resulting in loss of the entire volume above the sliding rail structures on either side of the enclosure.

There is a need, therefore, for an improved technique for retractably mounting computer components within a cabinet or rack. In particular, there is a need for a telescopically sliding rail mount which can reduce the profile of structures attached to server enclosures, effectively increasing the access volume when the server is retracted from the cabinet, and increasing the useful volume within the server enclosure. Furthermore, there is a need for a support structure for computer components which offers both the access and volume advantages aforementioned in a relatively simple structure consisting of interchangeable or symmetrical parts which can be mounted on either left or right-hand sides of a component cabinet.

SUMMARY OF THE INVENTION

The present invention provides a novel sliding rail mounting arrangement for a computer component rack designed to respond to these needs. The technique makes use of symmetrical components which can be mounted on either side of a support rack, and which significantly reduces the profile of components mounted directly adjacent to the component enclosure. The structure offers similar mechanical load-bearing capabilities to those of conventional structures, and may be configured to interface with racks of conventional design. By virtue of the reduced height profile of the sliding rail structure, volumes on either side of the component enclosure may be recaptured within the internal volume of the enclosure, for use in mounting internal circuitry and elements of the system. Similarly, the reduced height profile of the sliding rail components of the system permit greater access to the interior volume of the enclosures when the components are retracted from the cabinet for servicing.

Thus, in accordance with one aspect of the invention, a rack mounting system is provided for retractably supporting a computer system component in a computer rack. The system includes identical left and right support rails each being securable in the rack in mutually facing parallel relation. Each support rail includes first and second securement regions adjacent to longitudinal edges. The regions are symmetrical about the longitudinal axis of the support rail. The system also includes identical left and right slide assemblies secured to support regions of the support rails. The support rails may be recessed into the rack to provide additional space within the rack for the computer component. The slide assemblies are preferably substantially smaller in profile than the support rails, thus further reducing the space requirements of the system within the volume occupied by the component.

In accordance with another aspect of the invention, a rail assembly is provided for retractably supporting a computer component in a component rack. The rail assembly includes a support rail and a slide assembly. The support rail is secureable in a component rack and includes an elongated web portion and first and second flanges bordering the web portion. The support rail also includes first and second mounting regions which are symmetrical about its longitudinal axis. The slide assembly is configured to slidingly support the component on the support rail. The slide assembly includes mutually mating rails telescopically secured to another. The slide assembly is mountable on the support rail in either the first or second mounting region. The slide assembly may include multiple sets of telescoping rails, and preferably has a height profile substantially less than that of the support rail.

The invention also relates to a rack mounted computer system. The system includes a rack having front and rear access sides, and left and right side panels extending therebetween. A computer component having an enclosure for supporting internal hardware is mounted within the rack via left and right sliding support assemblies secured to left and right peripheral sides of the component enclosure. Each sliding support assembly includes a support rail and a slide assembly mounted to the support rail. The support rails are secured in the rack, while the slide assemblies extend between the respective support rails and a lower recess in the component enclosure. The support rails have support regions which are symmetrically disposed about a longitudinal axis, permitting the support rail to be used on either side of the rack, and identical slide assemblies to be secured thereto to define the sliding support assemblies.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

Figure 1 is a perspective view of a rack mounted computer system including a plurality of servers housed within a rack or cabinet;

Figure 2 is a detailed view of one of the servers of Figure 1 withdrawn from the rack via a sliding support rail structure;

Figure 3 is an exploded view of the server of Figure 2 illustrating a manner in which a component-mounted sliding rail may be secured to the component housing;

Figure 4 is an exploded view of a pair of support rails and slide assemblies for securing the structure of Figure 3 within a supporting component rack;

Figure 5 is a perspective view of a nut subassembly for use in securing the support rails of Figure 4 within a component rack;

Figure 6 is a perspective view of a portion of a support rail of the type shown in Figure 4 illustrating an exemplary manner in which the support rail may be mounted in the component rack;

Figure 7 is a perspective view of a front portion of a support rail of the type shown in Figure 4 following mounting to the component rack and after attachment of completed slide assemblies including rails of the type shown in Figures 3 and 4;

Figure 8 is a perspective view of a cable support structure for use in the rack mounting system, permitting cables to be extensively coupled between the rear portion of the rack and a rear face of a server or other component; and

Figure 9 is a partial sectional view of the fully assembled rail mounting system illustrating both left and right rail structures mounted to a server enclosure for supporting the server in the component rack.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Turning now to the drawings, and referring first to Figure 1, a rack-mounted computer system is illustrated generally and designated by the reference numeral 10. System 10 includes a plurality of components 12, such as individual servers, supported in a vertical mounting rack 14. In the illustrated embodiment, rack 14 is constructed within a storage cabinet 16. Rack 14 includes a rail system, designated generally by the reference numeral 18, for supporting the individual servers and for permitting the

servers to be recessed or inserted into the rack, or drawn from the rack for servicing, while remaining mechanically supported by cantilevered sliding rail arrangements as described more fully below.

Rack 14 and cabinet 16 include a front access opening 20 through which the servers may be retracted and reinserted, and a rear access opening 22 through which necessary connections may be made to the individual servers for coupling the servers to external components or to one another. Side panels 24 extend between front and rear access openings 20 and 22 to enclose the internal volume of the cabinet in which the servers are positioned. A front access door 26 is provided to close the cabinet when all of the servers are positioned in the rack. A similar access door (not shown) may be provided on rear access end 22, and may include a grill or perforated cover through which air may flow for cooling of the servers in a manner generally known in the art.

As shown in Figure 1 and 2, handles 28 are provided on a front side of each server 12 to facilitate retraction and reinsertion of the server in the rack, as indicated by bi-directional arrow 30. Moreover, each server includes an outer enclosure 32 having lateral sides 34. In the illustrated embodiment, recesses 36 are formed in lower regions of each lateral side to accommodate a sliding rail arrangement which supports the server in the rack, while permitting the server to be easily retracted and reinserted. An upper cover 38 of each server may be removed to access internal components supported within enclosure 32.

It has been found that in heretofore known retractable server rack mounting systems, access to internal components of the individual servers can be significantly hindered by the arrangement and profile of sliding rail structures used to support the servers. In the illustrated embodiment, the profile of the rail mounting structures is maintained at a minimum, and certain support rail structures are recessed into the rack as described more fully below, to provide a high degree of accessability to internal components within the individual servers as well as additional volume within the server enclosure for mounting of such components. In Figure 2, for example, a slot mounting structure 40 within enclosure 32 is accessable at lower regions due to the low profile of the rail mounting structures described below. Upper cover 38 may therefore be entirely removed down to the level of recesses 36 to gain access to such components.

As shown in Figure 2, the rail system includes a left rail assembly, designated generally by the reference numeral 42 and a right rail assembly 44, when viewed from a position in front of the server. As best illustrated in Figures 3 and 4, left rail assembly 42 includes a left support rail 46 (see Figure 4) and a left slide rail assembly 48. Similarly, right rail assembly 44 includes a right support rail 50 and a right slide rail assembly 52. The slide rail assemblies include rails designed to be fixed directly to the component enclosure, as illustrated in Figure 3, as well as additional rails for providing slidingly telescoping structures for ease of retraction and reinsertion of the component within the rack. As described more fully below, the elements of these rail structures on the left and right sides of the component are identical to one another but are assembled differently, thereby reducing the number of different parts in the rail system and facilitating assembly. Moreover, the support rail assemblies on the left and right sides

of the component include symmetrical mounting regions for securement to respective slide rail assemblies. It has been found that this structure, described more fully below, again reduces the number of different parts in the rail system, while offering a low profile for attachment to the component, and assuring a sufficiently rigid support system for attachment to the rack.

Referring specifically now to Figure 3, server 12 is illustrated adjacent to left and right component rails 54 and 56, respectively. Each component rail includes apertures 58 spaced along its length, which align with similar apertures 60 disposed in recesses of 36 on each side of the server. Nuts (not shown) retained within server 12 adjacent to recess 36 and behind apertures 60, receive fasteners 62 which traverse apertures 58 and 60 for attachment of rails 54 and 56 to the server enclosure. Rails 54 and 56 form part of slide rail assemblies 48 and 50, respectively. The remaining components of these assemblies are illustrated in Figure 4.

As shown in Figure 4, compound slide rail assemblies are secured to the support rails in one of two symmetrical support regions. It should be noted that in the illustration of Figure 4, the support and slide rail assemblies are shown from a rear perspective, opposite that of the front perspective of Figure 3, such that the left rails are illustrated in the lower position, while the right rails are illustrated in an upper position. As shown in Figure 4, each support rail 46 and 50 includes a rear securement bracket 64 and a front securement bracket 66 for fixing the support rails into the component rack as described below. Extending between the rear and front securement brackets, a central region 68 forms first and second mounting regions 70 and 72, disposed symmetrically

about a longitudinal axis 74 of each rail. The mounting regions 70 and 72 each include apertures 76 for receiving fasteners used to attach the slide rail assemblies to the support rails. Other structures of each rail, including the rear and front securement brackets, are similarly symmetrical about the longitudinal access 74 of each rail, enabling identical rails to be used on either left or right sides of the rack by inverting the rail about the longitudinal axis. Thus, as shown in Figure 4, first mounting region 70 is located in an upper position on right support rail 50, while the same region is located in a lower position on left support rail 46. The slide rail assemblies may be secured in either mounting region.

Referring to the illustrated embodiment of the rear securement bracket 64, each bracket structure is conveniently formed as an integral piece with the support rail, such as by a series of stamping and bending operations. Each rear securement bracket 64 includes a recessing extension 78 designed to place the mounting regions of the support rails in a recessed position within the rack with respect to the mounted component as described more fully below. The brackets further include an attachment flange 80 generally parallel to the recessing extension, and a linking plate or extension 82 extending between the recessing extension and the attachment flange. Engagement tabs 84 are formed on upper and lower extremities on each attachment flange 80, and anti-rotation extensions 86 extend in a forward direction from each engagement tab. The engagement tabs permit the rails to be mounted in a rack and to engage apertures in the rack, as described below, while restraining the rails from twisting under the moment created by the supported component. Finally, each rear securement bracket includes a pair of apertures 88 for receiving fasteners for securing the support rail to the rack.

Front securement brackets 66 on each support rail include a front attachment flange 90, having upper and lower engagement tabs 92, each terminating in an anti-rotation extension 94. While front attachment flanges 90 may be generally similar to attachment flanges 80 formed on rear securement brackets 64, should be noted that the anti-rotation extensions 94 extend in a forward direction, permitting the rails to be easily secured to the rack structure by a forward motion engaging all of the anti-rotation extensions into the rack on both front and rear ends as described below. A pair of clinch nuts 96 are supported behind each front attachment flange 90 and aligned with apertures (not shown) in the front attachment flanges for receiving fasteners used to secure the brackets to the rack.

Also as shown in Figure 4, slide rail assemblies 48 and 52 each include an inner slide rail 98 designed to mate with a component rail 54 or 56 (see Figure 3) to form a first telescoping set 100 of slide rails. In the illustrated embodiment, the slide rail assemblies each include a pair of such telescoping rail sets, including an outer pair of rails 102 and 104 which mate to form a second set 106. Slide rail sets 100 and 106 are secured to one another by securing rail 98 of the first set in a back-to-back relationship with rail 102 of the second set. Apertures 108 are formed through the slide rail sets to permit the slide rail sets to be secured to one of the mounting regions 70 or 72 of a support rail via fasteners (not shown).

The manner in which the rail assemblies described above are secured to the rack in accordance with a presently preferred arrangement is illustrated in Figures 5, 6, and 7.

Referring to Figure 5, rack 114 is conveniently formed with an integral rear mounting flange 110 extending inwardly on either side of the rack. A series of mounting apertures 112 are formed in the rear flange, such as in a square configuration, to facilitate mounting of the rails and other components of the system and to prevent twisting of the rails. To facilitate mounting of the support rails, a cage nut assembly 114 is conveniently secured to the rear flange to receive fasteners extending through rear securement brackets 64 (see Figure 6). In the illustrated embodiment, each cage nut assembly 114 includes a threaded nut 116 housed between an upper retaining clip 118 and a similar facing lower retaining clip 120. Retaining clips 118 and 120 are somewhat resilient, permitting them to be deformed slightly and inserted into an aperture 112 in rear flange 110. Following insertion of a cage nut assembly in appropriate locations along rear flanges 110 on both left and right sides of the rack, the support rails may be mounted to the rack as illustrated in Figure 6.

As shown in Figure 6, the cage nut assembly 114 is mounted in a location corresponding to the preferred level at which one of the mounting regions 70 or 72 of the support rail will be located. The support rails, such as right support rail 50 shown from a rear perspective view in Figure 6, are then positioned such that the rear flanges extend into a space between recessing extension 78 and attachment flange 80, and are urged in a forward direction to engage anti-rotation extensions 86 into corresponding apertures 112 on either side of cage nut assembly 114. A fastener 122 is then inserted into cage nut assembly 114 through one of the apertures provided in attachment flange 80 of each rear securement bracket. As fastener 122 is tightened in cage nut assembly 114, anti-rotation extensions 86 are lodged securely within apertures 112 to resist

torsion of the support rail in the rack. Similar securement is performed on a front side of the rack as described more fully below.

Figure 6 also illustrates a presently preferred arrangement of each support rail with respect to other features of the rack system. In particular, each support rail includes a first or upper flange 124 and a second or lower flange 126 provided on either side of an integral web 128. Mounting regions 70 and 72 are formed in web 128, and flanges 124 and 126 lend a greater resistance to torsional loading of the rail, while assisting in locating and supporting the slide rail assemblies in the mounting regions. The resulting structure has a height 130 as defined by the upper and lower flanges which is substantially greater than the reduced profile of the slide rail assemblies. Moreover, by virtue of the configuration of the support rail and securement brackets, the support regions 70 and 72 of the rails are recessed by a distance 132 in a direction generally away from the component. As discussed below with reference to Figure 9, this additional recessing affords a greater useful volume within the supported components as compared to heretofore known systems.

As the support rails are secured at a rear end as described above with reference to Figure 6, they are also secured at front ends as shown in Figure 7. In the exemplary configuration of Figure 7, the left support rail 46 is illustrated with a 2-set slide rail assembly already fixed in place. As discussed above, in practice, the slide rail assemblies will ordinarily be assembled as shown in Figure 7 only after attachment to the server or component 12 illustrated in broken lines in Figure 7. In addition to the integral rear mounting flanges described above, rack 14 also preferably includes an

integral front mounting flange 134 on either side of the component access opening. Front flanges 134 include apertures 112 similar to those of the rear mounting flanges. As the rear of each support rail is secured to the rear mounting flanges, as described above with reference to Figure 6, the front securement bracket 166 of each rail is also located at a desired level or position with respect to a front flange 134. As the rail is urged in a forward direction by tightening of a fastener 122 in the rear securement bracket structure (see Figure 6), the front securement bracket of the rail is urged towards an inner side of the front flange to urge the anti-rotation extensions of the front securement bracket into corresponding apertures 112. A fastener 136 is then inserted and secured in one of the clinch nuts 96 (see Figure 4) of the front securement bracket. Thus, in a straightforward manner, and employing only a single rear and a single front fastener, each support rail is secured in a desired location within the rack, and prevented from rotating under the weight of the supported component.

Also shown in Figure 7, the rails of each slide rail assembly set include flanges which mate to form inner and outer races of anti-friction bearings. Thus, as shown in Figure 7, each set includes a rail forming outer races by virtue of upper and lower flanges 138 and 140, and a smaller inner rail forming inner races by virtue of flanges 142 and 144. A series of anti-friction bearing elements 146 are disposed between the mutually facing inner and outer flanges to facilitate gliding or sliding motion of the smaller rail within the larger. Finally, stops or bumpers 148 may be provided within the slide rail assemblies to limit motion of one or more of the mutually engaging rails with respect to one another.

The mounting system in accordance with the present technique also facilitates support of cables and similar flexible conductors linked to the individual servers or components mounted within the rail system. Figure 8 illustrates an exemplary configuration of a cable arm 150 used to support such cabling (not shown in Figure 8 for the sake of clarity). Cable arm 150 is designed to be secured both to the component 12 and to rack 14 and to articulate between the component and the rack as the component is slid or retracted from the rack, or slid back into or reinserted into the rack. To facilitate attachment to the component and to the rack, the rear 152 of the component enclosure supports a component interface bracket 154, while a rack interface bracket 156 is secured to a rear flange 110 of the rack, such as via one or more fasteners 158.

Cable arm 150 includes a component-side mounting bracket 160 which is secured to component interface bracket 154 by means of one or more fasteners 158. On an opposite end of cable arm 150, a rack support bracket 162 is secured to rack interface bracket 156 by means of similar fasteners 158. In the illustrated embodiment, rack interface bracket 156 includes upper and lower anti-rotation flanges 159 which engage bracket 162 to prevent rotation of the cable arm and to maintain the cable arm in a cantilevered position behind component 12. The cable arm assembly further includes a series of support plates 164 pivotally secured to one another by hinges 166.

In the illustrated embodiment, the cable arm assembly is particularly well suited to maintaining cables in a desired envelope dimension of the component. In particular, a reference dimension 170 of the outer enclosure of component 12 is preferably used as a

basis for the overall height of the interfacing brackets and cable arm assembly components, such that all cable arm components and supported cables remain within the envelope dimension defined by the height 170. This dimensional constriction advantageously facilitates insertion and removal of components within the rack without requiring partial dismantling of support structures of neighboring components.

Figure 9 represents components of the fully assembled support and slide mounting structures described above and presently preferred dimensional relationships between the structures. In particular, as shown in Figure 9, identical left and right support rails of 46 and 50 are mounted within rack 14 on left and right flanges of the rack. Symmetrical mounting regions on each support rail receive corresponding left and right slide rail assemblies 48 and 52. In the embodiment illustrated in Figure 9, the slide rail assemblies are mounted in lower positions on the support rails. However, where desired, the slide rail assemblies may be mounted in mutually facing upper positions.

The preferred configuration of the support rail and slide rail assemblies facilitates the use of identical components throughout the system. In particular, not only are the support rails identical to one another, but individual slide rail sets within the slide rail assemblies may similarly be identical.

The foregoing structures offer the additional advantage of providing a low profile slide rail structure, while supporting the slide rail structure on a high moment of inertia support rail. Moreover, recessing of the support rails within the rack, while providing slide rail assemblies which extend into the region supporting the component

allows a maximum width dimension to be employed in the design of the component enclosure. Thus, the slide rail assemblies extend into the component enclosure only by a dimension slightly greater than that of the lower recess, as represented by reference numeral 172 in Figure 9, thus providing an enhanced component enclosure extension 174 on either side of the component. In the illustrated embodiment, the stacked sets of slide rails in the slide rail assembly provide a slide rail extension 176 which, in appropriate cases, may be further minimized by reduction in the width profile of the slide rail sets. Finally, the reduced height of the slide rails reduces the overall height dimension over which the rail support structure extends on each lateral side of the component. In the illustrated embodiment, the height of the slide rail assemblies, represented by reference numeral 178 in Figure 9, is approximately one half of the overall height of the support rails, allowing an approximately equal dimension to be added to the interior of the component enclosure and accessed upon removal of the upper cover of the enclosure.

While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and will be described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the invention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention as defined by the following appended claims.

CLAIMS

What is claimed is:

1. A rack mounting system for retractably supporting a computer system component in a component rack, the system comprising:

identical left and right support rails, each support rail being securable in the rack in mutually facing parallel relation, each support rail including a first securement region adjacent to a first longitudinal edge and a second securement region adjacent to a second longitudinal edge, the first and second securement regions being symmetrical about a longitudinal axis of the respective support rail; and

identical left and right slide assemblies, the left slide assembly being secured to the first securement region of the left support rail and the right slide assembly being secured to the second securement region of the right support rail.

2. The system of claim 1, wherein each of the first and second securement regions include a plurality of apertures for receiving fasteners for securing the slide assemblies to the respective support rails.

3. The system of claim 1, wherein the left and right support rails each include a central web and first and second flanges bordering the central web along the first and second securement regions.

4. The system of claim 3, wherein the left and right slide assemblies each have an installed height of less than half of a distance between the first and second flanges of the support rails.

5. The system of claim 1, wherein each slide assembly is a compound slide assembly including a plurality of mating rail sets stacked in a direction transverse to a sliding direction, each mating rail set being telescopically extensible over a portion of a retraction length of the component.

6. The system of claim 1, wherein the first securement region of the left support rail is disposed adjacent to a lower edge thereof and the second securement region of the right support rail is disposed adjacent to a lower edge thereof, whereby the slide assemblies are secured to the respective support rails in mutually facing lower positions.

7. A rail assembly for retractably supporting a computer component in a component rack, the rail assembly comprising:

a support rail securable in the component rack, the support rail including an elongated web portion and first and second flanges bordering the web portion and spaced from one another by a distance, the web portion having first and second mounting regions adjacent to the first and second flanges, the mounting regions being symmetrical about a longitudinal axis of the support rail; and

a slide assembly configured to be slidingly support the component on the support rail, the slide assembly including mutually mating rails telescopically secured to

one another, the slide assembly being mountable to the support rail in either the first or the second mounting region.

8. The assembly of claim 7, wherein the slide assembly has an installed height of approximately one half the distance between the first and second flanges of the support rail.

9. The assembly of claim 7, wherein the slide assembly is a compound slide assembly including a plurality of mating rail sets stacked in a direction transverse to a sliding direction, each mating rail set being telescopically extensible over a portion of a retraction length of the component.

10. The assembly of claim 7, wherein when installed in the support rail, the slide assembly extends from the support rail web by more than twice a width of the first or second flange.

11. The system of claim 7, wherein each of the first and second mounting regions include a plurality of apertures for receiving fasteners for securing the slide assembly to thereto.

12. A rack mounted computer system comprising:

a rack having front and rear access sides, and left and right side panels extending between the front and rear access sides;

a computer component having an enclosure for supporting internal hardware, the enclosure defining left and right peripheral sides, each peripheral side having a lower recess extending toward a center of the enclosure; and

left and right sliding support assemblies mounted in mutually facing relation within the rack generally parallel to the left and right side panels respectively, each support assembly including an identical support rail secured to the rack and a slide assembly mounted on the support rail, each support rail having first and second support regions symmetrically disposed about a longitudinal axis thereof, each slide assembly being mounted to a support regions of the respective support rail, the slide assembly of the left support rail being mounted to the first support region thereof and secured to the left peripheral side of the computer component enclosure in the left lower recess, and the slide assembly of the right support rail being mounted to the second support region thereof and secured to the right peripheral side of the computer component enclosure in the right lower recess.

13. The system of claim 12, wherein each slide assembly is mounted in a lower support region of the respective support rail.

14. The system of claim 12, wherein the first and second support regions of each support rail includes a plurality of apertures disposed symmetrically about the longitudinal axis thereof for securing the slide assemblies in either a lower or upper position with respect to the longitudinal axis.

15. The system of claim 12, wherein each slide assembly is a compound slide assembly including a plurality of mating rail sets stacked in a direction transverse to a sliding direction, each mating rail set being telescopically extensible over a portion of a retraction length of the component through the front access side of the rack.

16. The system of claim 12, wherein each slide assembly extends from a web portion of the respective support rail web by more than twice a depth of the support rail.

17. The system of claim 12, wherein each slide assembly has an installed height of approximately one half a height of the respective support rail.

18. The system of claim 12, further comprising a pliable cable support arm secured to the rear access side of the rack for carrying electrical conductors coupled to the computer component.

19. The system of claim 18, wherein the cable support arm is disposed in and is extensible within a height envelop dimension of the component.

20. The system of claim 12, wherein each support rail is secured to the rack via separable mounting brackets fixed to front and rear mounting flanges of the rack.

21. The system of claim 20, wherein the mounting brackets recess each support rail within the rack toward a respective side panel thereof.

ABSTRACT OF THE DISCLOSURE

A rail mounting arrangement for supporting a computer component, such as a server, in a rack includes a pair of support rails and slide rail assemblies supported by the support rail. The support rails are identical and include a pair of mounting regions on either side of a longitudinal axis. The slide rail assemblies have a lower profile than the support rails and may be mounted on either of the mounting regions. The slide rail assemblies are secured to the server and present a low profile, permitting greater access to internal components within the server housing for servicing. The support rails are recessed in the rack to reduce the space occupied by the rail system in the region of the rack in which the server is supported.

FIG. 1

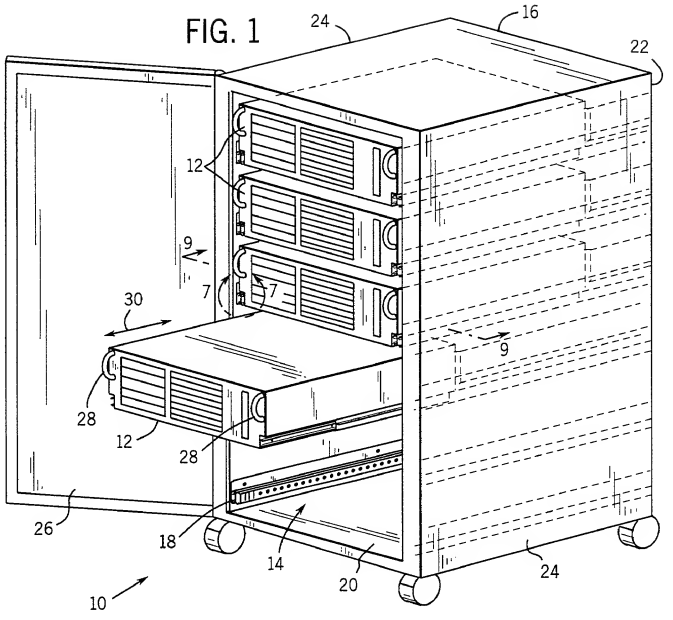
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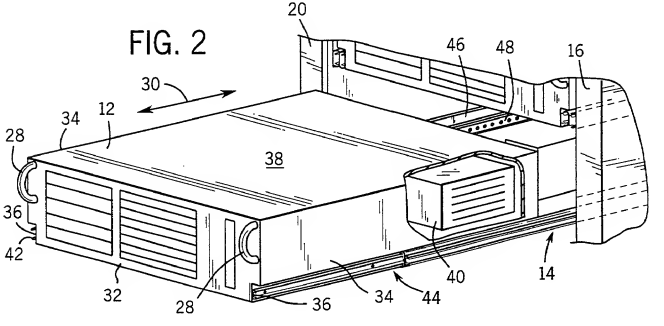
FIG. 2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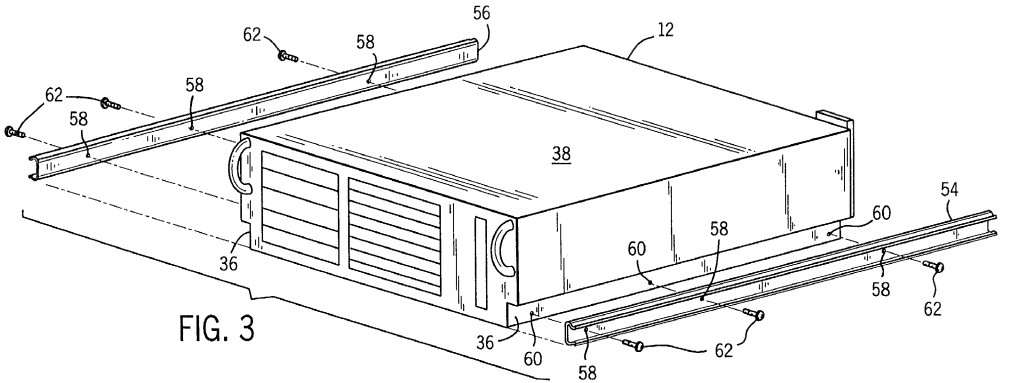

FIG. 3

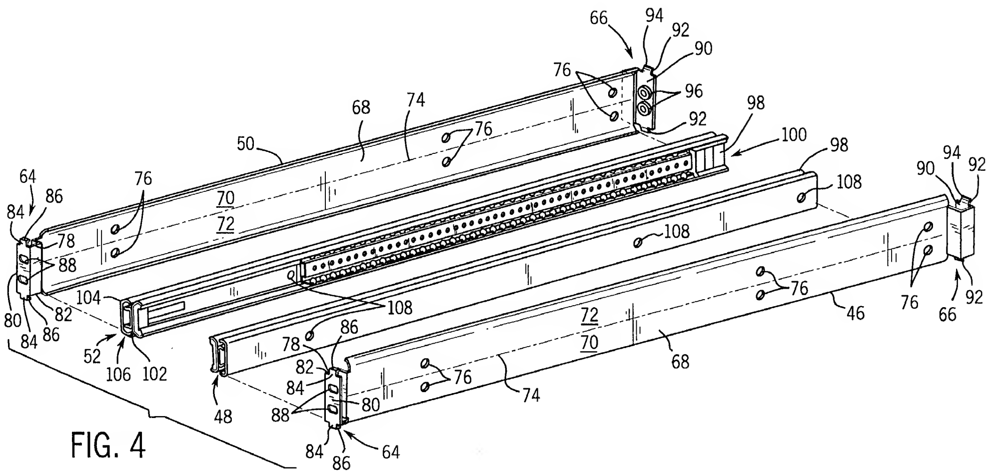
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FIG. 4

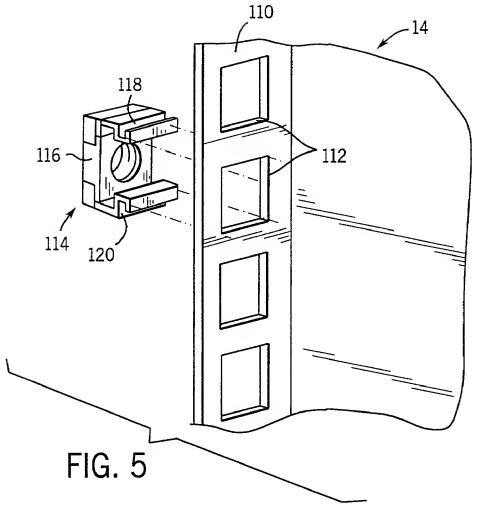
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FIG. 5

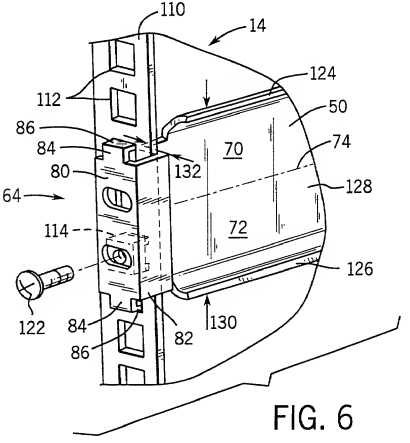
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FIG. 6

FIG. 7

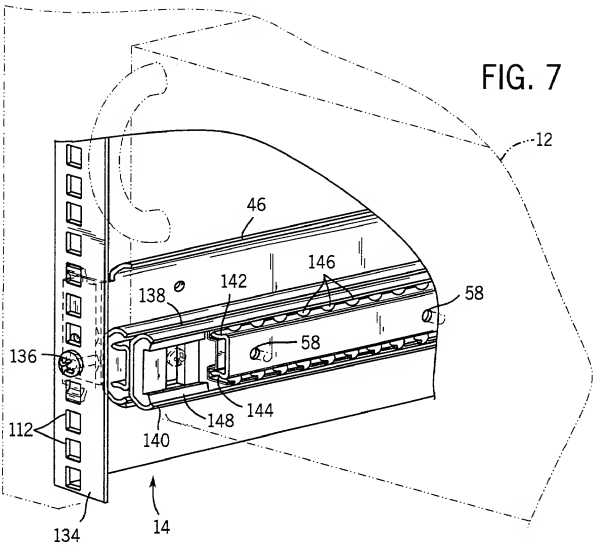
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FIG. 8

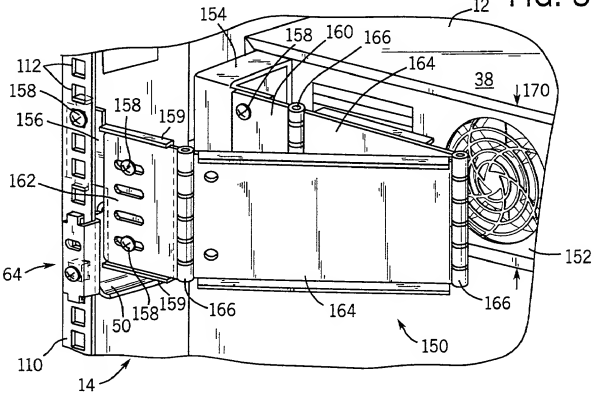
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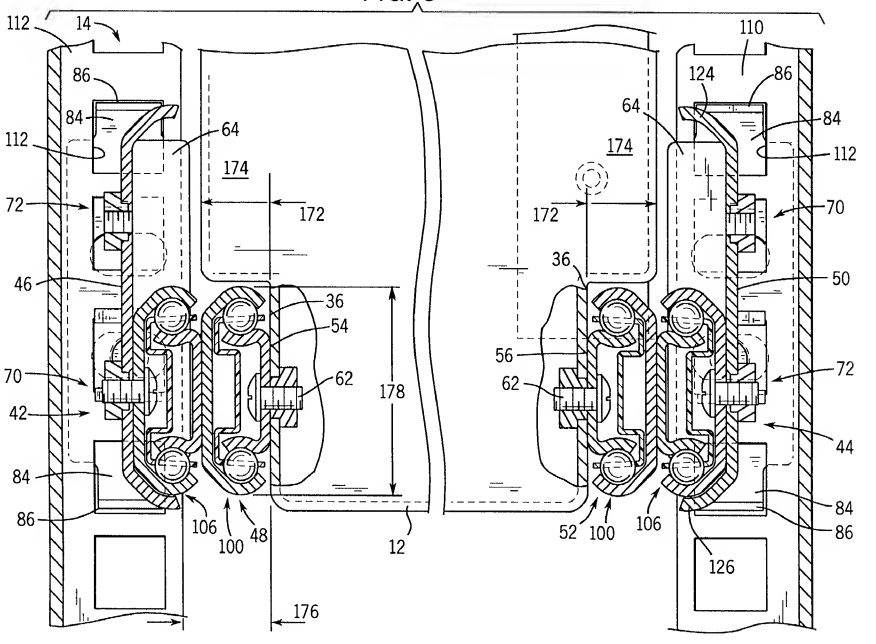
FIG. 9



Attorney Docket No. COMP:0016
P98-2056

DECLARATION

SOLE/JOINT INVENTOR
ORIGINAL/SUBSTITUTE/CIP

As a below named inventor, I hereby declare that: my residence, post office address, and citizenship are as stated below next to my name. I believe I am the original, first, and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

COMPUTER COMPONENT RACK MOUNTING ARRANGEMENT

as described in the specification [X] attached or [ ] of patent Application Serial No. _____ filed _____ and amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above; that I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application; that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representative or assigns more than twelve months prior to this application; and that I acknowledge the duty to disclose information of which I am aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations § 1.56(a). Such information is material when it is not cumulative to information already of record or being made of record in the application, and

(1) it establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or
(2) it refutes, or is inconsistent with, a position the applicant has taken or may take in:

(i) opposing an argument of unpatentability relied on by the Office, or
(ii) asserting an argument of patentability.

I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificates listed below and have also identified below any foreign application(s) having a filing date before that of the application(s) on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE OF FILING	PRIORITY CLAIMED UNDER 35 USC 119
			[ ] YES [ ] NO

I hereby claim the benefit under Title 35 United States Code § 120 of any United States application(s) listed below and, insofar as any subject matter of any claim of this application is not disclosed in the prior United States Application, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations § 1.56(a) which occurred between the filing date of the prior application and the national PCT international filing date of this application:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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POST OFFICE ADDRESS Same as above		
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Robert J. Hastings	§	
Paul E. Westphall	§	
	§	
Filed: Herewith	§	
	§	*Attorney File:* COMP:0016
Serial No.: Unassigned	§	P98-2056
	§	
For: COMPUTER COMPONENT RACK MOUNTING ARRANGEMENT	§	

POWER OF ATTORNEY BY ASSIGNEE

Under the provisions of 37 C.F.R. § 3.71, the undersigned assignee of record of the entire interest in the above-identified patent/patent application by virtue of an assignment recorded (check as applicable):

- [X] Concurrently Herewith
- [ ] Date Recorded
- [ ] Reel _____ Frame _____

elects to conduct the prosecution of the application/maintenance of the patent to the exclusion of the inventor(s). The undersigned hereby declares that he has reviewed the above-referenced assignment and hereby declares that, to the best of his knowledge, title is in the Assignee, and further declares that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true. The assignee hereby revokes any previous powers of attorney and appoints the following to prosecute this application/maintain this patent and transact all business in the Patent and Trademark Office connected therewith:

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Patrick S. Yoder	37,479	Keith Lutsch	31,851
Stephen E. Edwards	38,865	Joseph Arrambide	39,589
Robert A. Van Someren	36,038	Sarah T. Harris	35,891
		Barry Blount	35,069
		Jeffrey L. Garrett	38,149
		Laura C. Turley	35,850
		Howard R. Boyle	29,617
		T. Grant Ritz	39,819

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COMPAQ COMPUTER CORPORATION

Date: July 30, 1998 BY: Russell T. Wong

NAME: Russell T. Wong
TITLE: Director, Intellectual Property
Associate General Counsel